Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
	)	GN Docket No. 14-177
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	
	)	IB Docket No. 15-256
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	)	
	)	RM-11664
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	
	)	WT Docket No. 10-112
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services	)	
	)	IB Docket No. 97-95
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations	)	

COMMENTS OF NOKIA

Prakash Moorut
Nokia Bell Labs

Brian Hendricks
Jeffrey Marks
Government Relations

Nokia
1100 New York Avenue, NW
Suite 705 West
Washington, DC 20005

January 31, 2017

TABLE OF CONTENTS

I. INTRODUCTION AND SUMMARY 2

II. THE COMMISSION SHOULD DECLINE TO RECONSIDER THE TECHNICAL SHARING FRAMEWORK BETWEEN SATELLITE AND TERRESTRIAL OPERATIONS IN THE 28 GHZ BAND 3

A. The Commission Should Not Elevate FSS to Co-Primary Status in the 28 GHz Band 3

B. The Commission Should Not Reconsider the Order's Conclusions Regarding Aggregate Interference Limits 4

C. Nokia urges the Commission to deny Boeing's Petition for Reconsideration 7

III. NOKIA URGES THE COMMISSION TO GRANT CERTAIN PROPOSALS REGARDING TERRESTRIAL SERVICE RULES 10

A. The Commission Should Allocate at Least Part of the 64-71 GHz Band for Licensed Use 10

B. The Commission Should Clarify its Operability Requirement as It Relates to the 37-40 GHz Band 11

VIII. CONCLUSION 12

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
	)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	)	IB Docket No. 15-256
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664
	)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services	)	WT Docket No. 10-112
	)	
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations	)	IB Docket No. 97-95

COMMENTS OF NOKIA

Nokia respectfully submits Comments in response to multiple Petitions for Reconsideration of the Commission's Order in the above-captioned proceeding focused on terrestrial mobile in specific spectrum bands above 24 GHz ("*Order*").[1]

[1] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket Nos. 14-177 et al., Report and Order, 31 FCC Rcd 8014 (2016) ("*Order*").

I. INTRODUCTION AND SUMMARY

Nokia commends the Commission on the tremendous progress it is making in the area of spectrum policy. From its innovative 600 MHz Incentive Auction, to introducing commercial dynamic sharing into the 3.5 GHz band, to unlocking mmWave bands for terrestrial wireless sharing with fixed satellite service ("FSS") systems, the Commission is positioning the U.S. to be a global leader in the next generation of wireless. In its *Order*, the Commission took on a forward-looking initiative by unlocking the potential of over 14 GHz of spectrum for terrestrial mobile use in a single proceeding. We agree that the *Order* "take[s] a significant step toward securing the Nation's future in the next generational evolution of wireless technology . . . ."[2]

It is against this background that Nokia opposes Petitions for Reconsideration that seek to disrupt the technically justified balance struck by the Commission that will enable robust 5G services in bands shared with FSS. Specifically, in these Comments, Nokia first demonstrates that the Commission should not reconsider the *Order's* findings that: (1) satellite operations are secondary to terrestrial operations in the 28 GHz band; and (2) there is no valid basis to impose aggregate interference limits on Upper Microwave Flexible Use Service ("UMFUS") systems in the 28 GHz band. Nokia next urges the Commission to decline Boeing's Petition for Reconsideration, which seeks modifications to the technical rules at 37/39 GHz.

In addition, these Comments support certain requests for reconsideration that will facilitate terrestrial operations in bands considered in the *Order*. Nokia supports requests to allocate at least a portion of the 64-71 GHz band to licensed spectrum, and also requests to

[2] *Order* at ¶ 1.

reconsider the operability requirement for the 37/39 GHz bands, at least until such time service rules are in place for the 37.0-37.6 GHz portion of the band.[3]

II. THE COMMISSION SHOULD DECLINE TO RECONSIDER THE TECHNICAL SHARING FRAMEWORK BETWEEN SATELLITE AND TERRESTRIAL OPERATIONS IN THE 28 GHZ BAND

A. The Commission Should Not Elevate FSS to Co-Primary Status in the 28 GHz Band

The Satellite Industry Association ("SIA") asks the Commission to reverse its decision in the *LMDS First Report and Order* made over 30 years ago, and affirmed in the current *Order,* that FSS operations are secondary to terrestrial operations (fixed or mobile) in the 28 GHz band.[4] The Commission should deny SIA's request.

In its Petition, SIA recycles its claims that there is ambiguity regarding secondary status of FSS versus terrestrial *mobile* operations (as opposed to terrestrial *fixed* operations), where there is none. As the *Order* states, "FSS operators received multiple notices of their secondary status."[5] Addressing mobile specifically, the *Order* recounts that, in the 1996 *LMDS First Report and Order*, the Commission expressly contemplated introduction of terrestrial mobile services once technologically feasible.[6] The Commission "made no distinction between fixed and mobile service in terms of priority – it established priority for a terrestrial service over a satellite service."[7]

Such long-standing notice regarding secondary status of FSS, however, in no way impeded thoughtful consideration for FSS reliance on the 28 GHz band. This reliance led to the

[3] In this submission, Nokia addresses select issues. The omission in these Comments of a topic addressed by the various Petitions for Reconsideration in no way indicates Nokia's tacit agreement or opposition with respect to that topic.
[4] *Order* at ¶ 62 (citing LMDS First Report and Order, 11 FCC Rcd at 19024, para. 44).
[5] *Id.* ¶ 64.
[6] *Id.* ¶ 62.
[7] *Id.* (citing LMDS First Report and Order, 11 FCC Rcd at 19008, para. 6).

Commission's determination to "create new opportunities for continued expansion of FSS earth stations on a protected basis."[8] Protection, however, does not equal "co-primary." The Commission stated that, "*Upgrading* the FSS designation to co-primary status, *even if limited to individually licensed earth stations*, would be inconsistent with terrestrial use of this band and the Commission's decision to facilitate expanded terrestrial use, and would not effectively facilitate sharing in the band."[9]

SIA is correct that, by granting interference protection to certain FSS earth stations, the Commission bestowed a benefit that does not generally apply to secondary operations. However, SIA is disingenuous when it protests that "it is not expressly clear that such protected operations have co-primary status."[10] The opposite is true. In the same breath as the Commission granted interference protection to certain FSS earth stations, the Commission expressly stipulated that it declined to "*fully* upgrad[e] FSS under our service rules to co-primary status."[11] There is perfect clarity on this point: FSS does not have co-primary status in the 28 GHz band. The Commission should deny SIA's Petition.

B. The Commission Should Not Reconsider the Order's Conclusions Regarding Aggregate Interference Limits

Nokia opposes petitions[12] to reconsider the Commission's decision to authorize UMFUS operations in the 28 GHz band without setting specific limits on aggregate interference. In the *Order*, the Commission addressed satellite operators' purported concerns regarding skyward aggregate interference, and rejected calls to set specific limits finding that the record –

[8] *Id.* ¶ 50.
[9] *Id.* (emphasis added).
[10] Satellite Industry Association, Petition for Reconsideration, GN Docket No. 14-177 *et al.*, at 7 (filed Dec. 14, 2016) ("SIA Petition").
[11] *Order* at ¶ 50.
[12] SIA Petition at 11-13; SES Americom, Inc. and O3B Limited, Petition for Reconsideration, GN Docket No. 14-177 *et al.*, at 18-24 (filed Dec. 14, 2016) ("SES and O3B Petition").

both legal and factual – did not warrant such limits. The Commission found, "we have concluded that the satellite industry has not shown that it has a legal right to protection from aggregate interference or that harmful aggregate interference is likely to occur from the mobile operations now being authorized for LMDS."[13]

As a legal matter, the Commission cited FSS's secondary status as well as its consistently applied precedent declining to set similar limits in other bands.[14] Technical analysis also supports the finding. Nokia and other parties submitted ample analysis regarding a lack of evidence that terrestrial operations would cause harmful interference to FSS operations. For Nokia's part, we devoted substantial engineering resources to run simulations and provide technical analysis for discussion of such coexistence, which were presented at a series of meetings. Results from these coexistence studies were also submitted to the Commission.[15] Among Nokia's key conclusions was that it is not expected that aggregate interference from 28 GHz band terrestrial operations will cause harmful interference into satellite receivers (GSO and NGSO), and that limitations on terrestrial operations would not be required to mitigate against such interference.[16] After reviewing analyses submitted by "various parties, including satellite operators," the Commission determined that those studies "do not support establishment of an aggregate interference limit."[17]

[13] *Id.* ¶ 69.
[14] *Id.* ¶¶ 62-68.
[15] *See, e.g.*, Letter from AT&T Services Inc., Nokia, Samsung Electronics America, T-Mobile USA, Inc., and Verizon (together, the "Joint Filers") to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 *et al*. (filed May 6, 2016); *See* Letter from the Joint Filers to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 *et al*. (filed May 12, 2016); Letter from the Joint Filers to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 *et al*. (filed June 1, 2016) ("June 1 Joint Letter").
[16] June 1 Joint Letter at 1.
[17] *Order* at ¶ 67.

Despite ample analysis in the record to show that there is no potential for aggregate interference into FSS satellite receivers, SIA claims in its Petition that:

> To minimize the potential for aggregate interference into FSS satellite receivers of non-U.S. satellite networks, SIA proposes that UMFUS stations be limited to a maximum transmit power level of 10 dBW (40 dBm) per station in accordance with No. 21.5 of the ITU Radio Regulations, which was adopted in order to facilitate shared terrestrial/satellite use of the 28 GHz band.[18]

As an initial matter, it is questionable how the ITU Regulation cited by SIA applies in the United States. As SIA concedes, ITU Radio Regulation No. 21.5 applies only to bands where terrestrial and satellite operation share "equal rights,"[19] which is not the case in the U.S. with respect to the 28 GHz band. Moreover, the *Order* expressly considered its international treaty obligations and the Commission's long-standing determination to designate satellite operations as secondary in the 28 GHz band. The Commission determined that it "is not violating international treaty obligations by adopting rules that will enable the provision of UMFUS in the 28 GHz band without first resolving potential interference issues."[20]

Regardless, the *Order* continues, "the risk of interference is very low."[21] Further to that point, it is important to recognize that this radio regulation was developed well before 5G systems were developed and likely did not account for the unique features of 5G systems. As Nokia mentioned previously,[22] 5G systems are envisioned to utilize Grid-of-Beams (GoB) transmission methods at both Access Points and User Equipments, where a preferred beam direction for reception and transmission is derived based on explicit channel measurements at the intended receiver. With GoB, most, if not all, transmit power will be concentrated in a set of

[18] SIA Petition at 13.
[19] ITU Regulations article 21.1.
[20] *Order* at n.135.
[21] *Id.*
[22] Nokia, Reply Comments, GN Docket No. 14-177 et al., at 6-7 (filed, Feb. 27, 2016).

narrow beams directed at the intended receiver, usually deployed no higher than at street-level, and thus it is unlikely to cause any significant interference at the space station as demonstrated by Nokia's simulations. SIA's Petition fails to account for the vastly different technical assumptions that likely drove WRC-2000 compared to the 5G systems considered in the *Order*.

Based on technical analysis, legal precedent and policy determinations, the Commission determined that UMFUS should move forward without delay or the imposition of aggregate interference limits. The Commission's direction to the International Bureau and Office of Engineering and Technology to open a new docket for submission of additional interference data over time demonstrates the commitment of the Commission to FSS in the 28 GHz band. The Commission, however, leaves no doubt that it *has* resolved this issue in *this* docket, and found no further "Commission review or action" is required here.[23] Nokia agrees.

By opening a new docket the Commission closes the book on the issue of aggregate interference as it relates to this proceeding. The Commission should deny requests to revisit the issue of aggregate interference in this docket, and hold to its decision to revisit the issue only if warranted, in a newly established docket, based on future data submitted from actual deployment of UMFUS.

C. Nokia urges the Commission to deny Boeing's Petition for Reconsideration

Nokia urges the Commission to deny Boeing's Petition for Reconsideration, which describes a number of proposed changes to the technical rules in the 37/39 GHz band. Boeing argues that "robust spectrum sharing between satellite and UMFUS systems is achievable in the 37/39 GHz band if the Commission adopts a few reasonable and non-burdensome

[23] Order at ¶ 69 (ending discussion of aggregate interference in this docket, but ordering a new docket be created as a place parties can file "any relevant data demonstrating changes in the amount of aggregate interference on record *as UMFU services are deployed*" (emphasis added)).

measures."[24] Nokia disagrees with Boeing's proposals, and, in particular, that its requested changes to the technical rules for the band are "reasonable and non-burdensome."

For example, Boeing argues for a 5G base station power limit of 62 dBm EIRP. The Commission already rejected this exact request by Boeing in its *Order*.[25] As the Commission explained:

> Boeing's claim that the 75 dBm limit is inconsistent with the operational range of 5G applications is contradicted by the simulation results that show the benefits of increasing the maximum power beyond 62 dBm and the consensus among equipment manufacturers that 75 dBm is a reasonable power limit for UMFUS base stations. Furthermore, our rules for the 37.5-40.0 GHz band, about which Boeing expresses sharing concerns, limit the FSS to gateway-type earth station operations and prohibit the ubiquitous deployment of satellite earth stations designed to serve individual consumers. We do not believe that the higher power limit we are adopting will significantly affect the limited gateway FSS operations permitted in the band because we are providing a means for gateway earth stations in the band to obtain protection from terrestrial transmissions. [26]

In the 37/39GHz band, the earth stations are receiving and the satellites are transmitting resulting in the following two scenarios:

- Scenario 1 — Emissions from satellites into 5G receivers on the ground.
- Scenario 2 – Aggregate emissions from 5G transmitters into satellite earth stations receivers on the ground.

Regarding scenario 1, 5G Americas has submitted data to the Commission showing that "there would be much higher NGSO FSS interference into UMFUS 5G user equipment than presented by Boeing and well above the protection criteria threshold for mobile service, I/N = -6 dB, as characterized by ViaSat."[27]

---

[24] The Boeing Company, Petition for Reconsideration, GN Docket No. 14-177, at 6 (filed Dec. 14, 2016) ("Boeing Petition").
[25] *Order* at ¶ 278.
[26] *Id.*
[27] 5G Americas, Opposition, *The Boeing Company, Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service*, File No. SAT-LOA-20160622-00058 (filed Dec. 1, 2016) (citing Comments of ViaSat, GN Docket No. 14-177, at Exhibit B (filed Sept. 30, 2016).

In order to accurately assess scenario 2 and decide if satellite and 5G systems can coexist in 37/39 GHz as Boeing claims, it is important to model the receiver characteristics of the satellite earth stations which would have to coexist with 5G systems on the ground. While information about 5G transmitters is available publicly from many sources, including from a Joint filing made by AT&T, Nokia, Samsung, T-Mobile, and Verizon,[28] such information is not readily available for the earth station receivers such as their receive beamforming pattern in azimuth (towards the horizon). In addition, Boeing claims a certain amount of isolation between the 5G systems and the earth stations without justifying it. Nokia looks forward to obtaining the parameters about the earth stations in 37/39 GHz in order to conduct such an assessment.

Boeing also asks that the Commission "[p]ermit satellites to transmit in the 37/39 GHz band at the ITU power levels."[29] We agree with the Commission when they say that they "do not believe the current record is sufficient for us to conclude that authorizing satellites to operate at the higher PFD of -105 dBW/m^2/MHz would be consistent with terrestrial use of the 37.5-40 GHz band."[30]

Finally, Boeing also suggests that the Commission "[r]equire 5G systems to use beamforming and power control."[31] We disagree with Boeing's request to impose such requirements on 5G systems, since features "such as antenna downtilt, suppression of sidelobes and adaptive power control will occur naturally because they are inherent characteristics of anticipated 5G technologies."[32] Therefore, there is no need to promulgate such requirements.

[28] *See* Letter from the Joint Filers to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 *et al*. (filed May 6, 2016).
[29] Boeing Petition at 6.
[30] *Order* at ¶ 497.
[31] *See* Boeing Petition at 6.
[32] *Order* at ¶ 294.

For these reasons, Nokia respectfully requests that the Commission deny the Boeing Petition for Reconsideration.

III. NOKIA URGES THE COMMISSION TO GRANT CERTAIN PROPOSALS REGARDING TERRESTRIAL SERVICE RULES

A. The Commission Should Allocate at Least Part of the 64-71 GHz Band for Licensed Use

Several parties have pointed out the stark disparity in licensed to almost double the unlicensed spectrum allocated in the *Order*. The Commission notes that a pure comparison of number of megahertz does not tell the whole story.[33] Nokia urges, however, that such a MHz comparison should not be dismissed out of hand, as it appears the Commission did in the *Order*.

Specifically, Nokia supports calls for the Commission to reconsider allocating the entirety of the 64-71 GHz band to unlicensed operations.[34] The Commission's decision created a 14 GHz unlicensed block (when combined with the existing unlicensed allocation from 57-64 GHz). Nokia favors an all-of-the-above approach to spectrum, and is an industry leader developing unlicensed and spectrum sharing technologies. However, the Commission's decision to allow for zero MHz of exclusive licensed spectrum over that entire 14 GHz span is a missed opportunity to facilitate a diversity of services and business models, that could lead to greater investment in 5G networks.

International harmonization can also be a driver of 5G ecosystems. As Nokia pointed out in its Comments, the 66-71 GHz band is among the bands to be studied in ITU towards WRC-19, and has the potential to become a true globally harmonized band, which is one

[33] *Order* at ¶ 130 (questioning calls for "gigabit parity").
[34] T-Mobile USA Inc., Petition for Reconsideration, GN Docket No. 14-177 *et al.*, at 7-8 (filed Dec. 14, 2016) ("T-Mobile Petition"); Competitive Carriers Association, Petition for Reconsideration, GN Docket No. 14-177 *et al.*, at 5-8 (filed Dec. 14, 2016); CTIA, Petition for Reconsideration, GN Docket No. 14-177 *et al.*, at 19-24 (filed Dec. 14, 2016).

of the benchmark criteria suggested by the Commission.[35] Spectrum harmonization promotes economies of scale and enables global roaming, which reduces equipment design complexity and to improves spectrum efficiency.[36] All of this ultimately reduces costs for consumers. Device costs are a significant issue, and widely supported spectrum bands and channels can lower the crucial component costs. The Commission concedes this point, but nevertheless dismisses these benefits and denies calls for licensed spectrum for unspecified "U.S.-specific factors."[37]

In support of the Petitions for Reconsideration addressing these bands, Nokia suggests that the Commission allocate at least 66-71 GHz to licensed services and 64-66 GHz to unlicensed services, which would still provide an indisputably generous amount of contiguous unlicensed spectrum to unlicensed operations.

B. The Commission Should Clarify its Operability Requirement as It Relates to the 37-40 GHz Band

Nokia agrees that there are substantial benefits that are gleaned for the equipment ecosystem by that equipment being operable across a range of spectrum. However, we share concerns voiced by T-Mobile and the Competitive Carriers Association regarding an operability requirement across the 37/39 GHz bands. As T-Mobile states, ". . . the upper segment of the 37/39 GHz band . . . will almost certainly be available for use before a licensing and/or sharing regime is adopted for the 37 GHz Lower Band Segment."[38] By setting aside the 37.0-37.6 band for shared use, and the remainder of the spectrum range for exclusive licensed use, the Commission has injected complexity into the question of how the different band segments will be used and when they will be available. Nokia agrees with T-Mobile that, "There is no reason

[35] Nokia, Comments, GN Docket No. 14-177 *et al.*, at 17 (Jan. 27, 2016)
[36] *See* Document 5D/246-E, Canada's input to ITU-R WP 5D, "Technical perspective on benefits of spectrum harmonization for mobile services and IMT," 23 January 2013.
[37] *Order* at ¶ 130.
[38] T-Mobile Petition at 11.

why introduction of the upper segment of the 37/39 GHz band should be held hostage in order to also incorporate any further operational protocols the Commission ultimately adopts for the 37 GHz Lower Band Segment."[39] As such, the Commission should reconsider and clarify the operability requirement in the 37/39 GHz band to ensure that requirement does not impede deployment of 5G services in the band.

VIII. CONCLUSION

For the foregoing reasons, the Commission should deny the petitions for reconsideration that seek to alter the justified balance struck by the *Order* related to sharing between terrestrial and satellite communications. However, Nokia does support certain proposals, such as those to include licensed services for at least a portion of the 64-71 GHz band and to clarify the operability requirement in the 37-40 GHz band.

Respectfully submitted,

Nokia

/*Brian Hendricks*/

Brian Hendricks
Jeffrey Marks
Government Relations

Nokia
1100 New York Avenue, NW
Suite 705 West
Washington, DC 20005

Prakash Moorut
Nokia Bell Labs

January 31, 2017

[39] *Id.*